

HOST SUITABILITY OF SOME MEDICINAL PLANTS TO *Meloidogyne incognita* INFECTION UNDER GREENHOUSE CONDITIONS

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ABSTARCT

The host suitability of ten medicinal plant species i.e. carnation, celery, coriander, dill, geranium, peppermint, periwinkle, rose geranium, thorn apple and thyme to *Meloidogyne incognita* infection indicated that none of the tested plant species was immune and the incidence varied from plant species to another. Their host category was determined through the relationship between host plant growth response (% reduction of total plant fresh weight) or gall index and nematode reproduction factor (RF). Carnation and thyme were rated as highly susceptible (HS) or susceptible (S) hosts, since their plant growth parameters were highly affected along with reproduction factor >1. Rose geranium was rated as moderately intolerant (IT) or moderately resistant (MR), since its plant growth character was moderately affected along with reproduction factor <1 . Geranium was rated as fairly resistant (FR) or (MR), since its plant growth criterion was moderately affected with reproduction factor >1. Dill, celery, coriander, thorn apple and periwinkle were classified as resistant (R) or moderately resistant (MR)hosts, since their plant growth were not affected with reproduction factors <1, depending upon the host suitability designations used.

Keywords : Host suitability, ten medicinal plants, *Meloidogyne incognita*, reproduction factor (RF)

INTRODUCTION

Root-knot nematodes (*Meloidogyne* spp.) are one of the most wide spread and damaging agricultural pests in the world causing an estimated US \$100 billion loss/ year worldwide (Oka *et al* ., 2000). They were widely distributed in the cultivated areas of Egypt causing remarkable crop losses, particularly with eggplant, pepper yields. However, the host status of several plant species has remained unexplored. Resistant cultivars may provide an effective, economical and environmentally safe method for managing nematodes. The current availability and/or use of resistant cultivars and root stocks for nematode management reflects the success of research efforts in identifying and evaluating resistance sources, incorporating them into commercially acceptable crop selections, and implementing them into management programs (Ferris, 1992). The knowledge of host suitability of medicinal plants to root-knot nematodes is necessary to predict the potential effect on plant production and also the influence of each plant on nematode populations with regard to increasing or decreasing the risk of root-knot nematode on susceptible crops to be cultivated after plants.

The objective of the present investigation was to study the host suitability of ten medicinal plant species, to the root knot nematode, *Meloidogyne incognita* infection under green house conditions ($28 \pm 3^\circ\text{C}$).

MATERIALS AND METHODS

A green house experiment was conducted in order to evaluate ten medicinal plant species namely: carnation, celery, coriander, dill, geranium, peppermint, periwinkle, rose geranium, thorn apple and thyme for their susceptibility or resistance to the root-knot nematode, *M. incognita* infection. Sixty plastic pots 10 cm-d filled with 900 g steam-sterilized sandy loam soil (1:1) (v:v) were used in this experiment, where thirty six pots were planted with 3 seeds from each of the following plants, carnation, celery, coriander, dill, periwinkle and thorn apple and thinned to one plant often twenty five days from planting. In the mean time, the other twenty four pots were separately planted with cutting of each of geranium, peppermint, rose geranium and thyme (one cutting/pot). Six pots were used for each plant species, where three of them were inoculated with 1000 j2 of *M. incognita* one month after planting, while the other three pots were left free of nematode inoculum to serve as control (CK). Plants were allowed to grow for 45 days at $28 \pm 3^\circ\text{C}$. At the end of experiment, plants were uprooted and roots were washed from adhering soil. Data dealing with length and fresh weight of shoot and root and shoot dry weight were measured and recorded. Infected roots were stained in lactic acid fuchsin (Byrd *et al.*, 1983) and determined the number of developmental stages, females, egg masses and galls under stereomicroscope and recorded. Soil of each pot were processed for nematode extraction by sieving and modified Baermann-Technique (Goodey, 1957). Root galling (RGI) as well as egg masses (EI) were rated on a scale of 0 to 5 where 0=no galls or egg masses, 1= 1-2, 2=3-10, 3= 11-30, 4=31-100, 5= more than 100 galls or egg masses per root system (Taylor and Sasser, 1978). Host susceptibility was based on the relationship between reproduction factor (RF) and indices of galls (Canto-Saenz, 1983) or plant growth response (% reduction of total plant fresh weight) and nematode reproduction factor (RF). Data were subjected to analysis of variance (ANOVA) (Gamez and Gomez, 1984), followed by Duncan's multiple range test to compare means (Duncan, 1955).

RESULTS AND DISCUSSION

Results of growth response of ten medicinal plants to *M. incognita* infection are presented in Table (1) and Figure (1). In general, the growth of most tested plants were slightly affected by nematode infection, except of thyme and carnation, since their reduction percentage values were 47.1 and 60.5%: and 35.2 and 44.0% for total plant fresh weight and shoot dry weight, respectively comparing to nematode alone, (Table 1 & Fig. 1). Among the tested plants, geranium, coriander and rose geranium exhibited moderately decline in both total plant growth fresh weight and shoot dry weight with values of (17.2 and 6.9%, 15.4 and 10.0% and 10.8 and 18.9%, respectively, comparing to nematode alone. The effect of most tested medicinal plants against *M. incognita* infection indicated that they have nematocidal properties,

except that of carnation, thyme which were classified as highly susceptible hosts.

The screening of medicinal plant species revealed that none of the tested plant species was immune to root-knot nematode *M. incognita* infection, though the incidence varied from plant species to another. Evaluation medicinal plant species differed greatly in their abilities to support *M. incognita* populations (Table 3). Of the screened ten plant species, thyme exhibited the highest rate of nematode reproduction (RF=1.1) followed by carnation (RF=1.01), respectively. Moreover, number of galls and egg masses recovered from roots differed among tested plant species. Likewise, the great number of galls was recovered on thyme (150) and carnation (100) with root gall indices (RGI) 5 and 5, respectively. Similar trend was noticed with number of egg masses for the same plant species with egg masses indices 5 and 5, respectively.

Host category of the tested medicinal plant species was decided based on the relationship between either host plant growth responses (% reduction of total plant fresh weight or gall index and nematode reduction factor (RF). Carnation and thyme were rated as highly susceptible (HS) or susceptible (S) hosts, since their plant growth parameters were highly affected along with reproduction factor >1 . Rose geranium was rated as moderately intolerant (IT) or moderately resistant (MR), since its plant growth was moderately affected along with reproduction factor <1 . Geranium was rated as fairly resistant (FR) or moderately resistant (MR), since its plant growth parameter was moderately affected with reproduction factor >1 . Dill, celery, coriander, thorn apple and periwinkle were classified as resistant hosts (R) or (MR), since their plant growth were not affected with reproduction factors <1 , depending upon the host suitability designations followed (Table 3)

Apparently, results of the present work firstly revealed that the suitability of the tested ten medicinal and aromatic plant species to nematode infection where none of them was immune and the incidence varied from plant species to another. Obviously carnation and thyme were rated as highly susceptible hosts (HS) or (S) based on the highly affected of plant growth with $RF > 1$, Rosa germanium was rated as a moderately intolerant (IT) or (MR), where the moderately affected of plant growth with $RF < 1$. Geranium was rated as fairly resistance (FR) or (MR), where the moderately affected of plant growth with $RF > 1$. Dill, celery, coriander, thorn apple and periwinkle were classified as resistant hosts (R) where the unaffected plant growth with $RF < 1$. These findings disagreed with those reported by Wang and Mscorley (2005) in respect to white dill that was less susceptible than snapdragon. The present results are in agreement with those reported by El-Derriny (2009) who stated that, mountain thyme, (*Plectranthus amboinicus*) and carnation, (*Dianthus caryophyllus*), were found to be either susceptible or highly susceptible to *M. incognita*, where the reproduction factor was more than one to 5 times, resulting in great decrease to plant growth, and that of Fernandez *et al.*, (1991); Walker *et al.*, (1994) Cho *et al.*, (1996); Johnson *et al.*, (2003) and Khanna and Jyoti, (2004) who recorded the susceptibility of carnation to *M. incognita*.

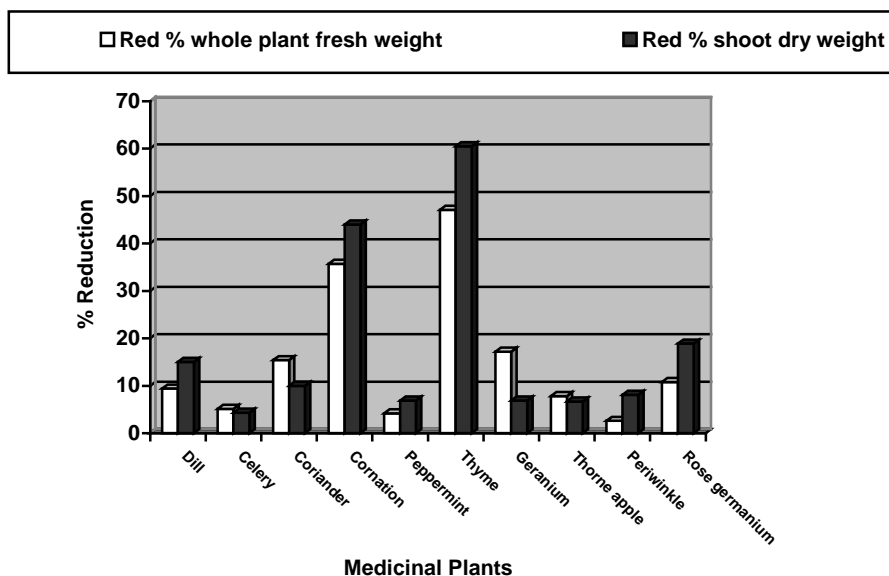


Fig.(1): Reduction percentage of whole plant and shoot dry weights of ten medicinal plant species as influenced by *Meloidogyne incognita* infection under greenhouse conditions ($28 \pm 3^\circ\text{C}$).

Table (2): Development and rate of *Meloidogyne incognita* reproduction on ten medicinal plant species under greenhouse conditions ($28 \pm 3^\circ\text{C}$):.

Treatments Plant species	*Nematode population in			Total (Pf)	**RF	No. of galls	*** RGI	No. of egg masses	**** EI
	Soil/pot	Root							
		Develop. stages	Females						
Carnation	860.0 a	20.0 be	125.0 cd	1005	1.01	100 bc	5	120b	5
Celery	450 d	29.0 e	14.0 cd	493	0.49	15bc	3	10b	2
Coriander	450 d	25.0 b	16.0 c	491	0.49	15bc	3	10b	2
Dill	612 c	10.3 de	20.0 c	642.3	0.64	19bc	3	10b	2
Geranium	604 c	12.0 cde	14.0 cd	630	0.63	16bc	3	12b	3
Peppermint	500 ed	15.0 cde	2.0 e	517	0.52	1.0d	1	1.0 c	1
Periwinkle	98 e	20.0 bc	12.0 cd	130	0.13	18bc	3	10b	2
Rose geranium	415 d	10.0 de	13.0 cd	438	0.44	16bc	3	11b	3
Thorne apple	80 e	18.0 bed	10.0 d	108.0	0.11	12.0c	3	9.3b	2
Thyme	800 b	100.0 a	155.0 a	1055	1.1	150.0a	5	140.0a	5

Pi=1000 J2 of *M. Incognita*

*Reproduction factor (Rf) = Final population (Pf) / intial population (Pi).

**Each value is a mean of three replicates.

Means in each column followed by the same letter(s) did not differ at $p < 0.05$ according to Duncan's multiple-range test.

Table (3): Host susceptibility of ten medicinal plant species to *Meloidogyne incognita* infection under greenhouse conditions (28± 3°C).

Plant Species	Total plant Fresh weight Red. %	Shoot dry wt Red %	RF	RGI	**Host category 1	**Host category 2
Carnation	35.2	44	1.01	5	HS	S
Celery	5.1	4.3	0.0.49	3	R	MR
Coriander	15.4	10.0	0.49	3	R	MR
Dill	9.4	15.0	0.64	3	R	MR
Geranium	17.2	6.9	0.63	3	FR	MR
Peppermint	4.2	6.9	0.52	1	R	R
Periwinkle	2.6	8.1	0.13	3	R	MR
Rose geranium	10.8	18.9	0.44	3	IT	MR
Thorne apple	7.8	6.7	0.11	3	R	MR
Thyme	47.1	60.5	1.1	5	HS	S

*Each value is a mean of three replicates. *Host category (1) based on the relationship between host response and R factor as follows:

0-10% reduction in plant growth; RF=0 Highly Resistant (HR)

RF<1 Resistant (R)

RF>1 Tolerant (T).

11-30% reduction in plant growth; RF<1 Fairly Resistant (FR)

RF> 1 Susceptible (S).

30%> reduction in plant growth; RF < 1 Intolerant (IT)

RF>1 Highly Susceptible (HS).

**Host category (2) according to Canto-Saenz (1983) as follows:

(RGI ≤ 2 & R ≤ 1) resistant (R), (RGI ≤ 2 & R > 1) tolerant (T) , (RGI > 2 & R ≤ 1) Moderately Resistant (MR) and (RGI > 2 & R > 1) susceptible (S).

The present results with the susceptibility of mountain thyme, *P. amboinicus* to *M. incognita* did not differ with the findings of Maciel and Ferraz (1996) who reported the susceptibility of *P. barbatus* to *M. incognita* and *M. javanica*.

On the other hand, periwinkle, *Catharanthus roseus* was found to be resistant to *M. incognita* in which reproduction factor was less than one and plant growth was unaffected. This result is in accordance with those reported by Gandarilla *et al.*, (1991) and McSorley and Frederick, (2001) in respect to *M. incognita* on *C. roseus* and William, (2003) who reported that *C. roseus* was poor or non-preferable host to *M. incognita*. However, the present results indicated that rose geranium *Pelargonium odoratissimum* was rated as moderately intolerant (IT) with RF <1 and plant growth was moderately affected. These findings disagreed with those of El-Derriny (2009) in respect to rose geranium that was found to be resistant to *M. incognita*.

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حساسية عشرة أنواع من النباتات الطبية للإصابة بنيماتودا تعقد الجذور *Meloidogyne incognita* تحت ظروف الصوبة السلكية أحمد جمال الشريف* ، عبد الفتاح رجب رفاعي* ، محمود السيد النجار** و ميادة مصطفى حفني**
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** معهد بحوث وقاية النباتات – مركز البحوث الزراعية – وزارة الزراعة – الدقي - الجيزة

في هذه التجربة تم دراسة حساسية 10 أنواع من النباتات الطبية والعطرية وهي القرنفل، والكرفس، والكزبرة والشبث، والجارونيا، والنعناع، الونكا، الزعتر و العتر والداثوراه للإصابة بنيماتودا تعقد الجذور *M. incognita* تحت ظروف الصوبة السلكية وقد أوضحت النتائج ما يلي:-

1. لم يتم تسجيل اي من الأنواع النباتية المختبرة منيعة للإصابة بالنيماتودا .
2. تفاوتت درجة الإصابة بين الأنواع النباتية المختبرة وتم قياسها بالنسبة بين معدل الانخفاض في المقاييس النباتية ومعدل تكاثر النيماتودا.
3. تم تصنيف القرنفل والزعتر كنباتات حساسة للإصابة (HS) أو (S)، حيث تأثرت بشدة بالإصابة وكان معدل تكاثر النيماتودا < 1.
4. تم تصنيف نبات العتر كنباتات غير متحملة للإصابة (IT) او متوسطة المقاومة (MR) حيث تأثرت بشدة بالإصابة النيماتودية وكان معدل تكاثر النيماتودا > 1، في حين تم تصنيف الجارونيا التي أنه مقاوم الي حد ما حيث كان معدل التأثير بالإصابة بمعتدل ومعدل تكاثر النيماتودا < 1.
5. تم تصنيف الشبث، والكرفس، والكزبرة والداثوراه والونكا كنباتات مقاومة (R) أو متوسطة المقاومة (MR) حيث لم يتأثر نموها وكان معدل تكاثر النيماتودا عليها > 1.

قام بتحكيم البحث

كلية الزراعة – جامعة المنصورة
كلية الزراعة – جامعة القاهرة

أ.د / فاطمه عبد المحسن مصطفى
أ.د / عبد المنعم ياسين الجندي

Table (1): Plant growth of ten medicinal plant species as influenced by *Meloidogyne incognita* infection under greenhouse conditions (28± 3°C).

Treatments	*Plant growth response									
	Length (cm)		Total length	% Red **	Fresh weight (g)		Fresh weight of whole plant	% Red **	Shoot dry weight (g)	% Red **
	Shoot	Root			Shoot	Root				
Dill + N	15 hi	3.0 h	18.0 f	7.7	12.0 f	2.5 def	14.5 def	9.4	1.7 fg	15.0
Dill (ck)	16hi	3.5 gh	19.5 f	--	13.0 f	3.0 def	16.0 cdef	--	2.0 efg	---
Celery + N	20 g	6.9 efg	26.9 e	11.2	19.0cd	3.3 def	22.3 cdef	5.1	4.5 bc	4.3
Celery (ck)	22.3 fg	8.0 efg	30.3 e	--	19.5 cd	4.0def	23.5 bcdef	--	4.7 bc	--
Coriander + N	9.0 j	2.5 h	11.5 g	8.0	4.0 def	1.5 ef	5.5 def	15.4	0.9 g	10.0
Coriander (ck)	9.5 j	3.0 h	12.5 g	--	4.5 de	2.0def	6.5def	--	1.0 fg	--
Carnation + N	22.5 fg	24.0 ab	46.5 c	5.1	7.5 ef	1.7 f	9.2 f	35.2	2.8 cdefg	44.0
Carnation (ck)	24.0 efg	25.0 ab	49.0 bc	--	12.7 def	1.5 ef	14.2 def	--	5.0 b	--
Peppermint + N	30.3 cd	24.0 ab	54.3 ab	7.2	35.5 a	21.8 b	57.3 a	4.2	13.5 a	6.9
Peppermint (ck)	34.5 bc	24.0 ab	58.5 a	--	36.05 a	23.75 a	59.8 a	--	14.5 a	--
Thyme + N	18.0 ghi	8.0 efg	26.0 e	5.5	12.5 f	3.7 def	16.2 def	47.1	1.5 fg	60.5
Thyme (ck)	18.5 gh	9.0 def	27..5 e	--	25.0 b	5.0d	30.6 bc	--	3.8 cd	--
Geranium + N	22.5 fg	27.0 a	49.5 bc	4.8	23.5 bc	2.5 def	26.0 bcde	17.2	2.7 cdefg	6.9
Geranium (ck)	24.0 efg	28.0 a	52.0 abc	--	28.5 b	2.9 def	31.4 bc	--	2.9 cdefg	--
Thorne apple + N	14.3 i	11.0 de	25.3 e	3.8	5.5 d	5.1 d	10.6 def	7.8	1.4 fg	6.7
Thorne apple (ck)	14.8 hi	11.5 d	26.3 e	--	6.2 g	5.3 d	11.5 def	--	1.5 fg	--
Periwinkle + N	36.0ab	18.0 c	54.0 ab	8.5	22.0 c	15.5 c	37.5 b	2.6	3.4 cd	8.1
Periwinkle (ck)	38.0 a	21.0 b	59.0 a	--	22.5 c	16.0 c	38.5 b	--	3.7 cd	--
Rose geranium + N	26.0 ef	24.0 ab	50.0 bc	9.1	16.0 e	3.0 def	19.0 cdef	10.8	3.0 cde	18.9
Rose geranium (ck)	30.0 def	25.0 ab	55.0 ab	--	18.0 d	3.3 def	21.3 cdef	--	3.7 cd	--

N=1000 J2 of *M. incognita*

***Each value is a mean of three replicates.**

Means in each column followed by the same letter(s) did not differ at p<0.05 according to Duncan's multiple-range test.

Ck= non-inoculated.